

PATENT ABSTRACTS OF JAPAN

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(54) OPTICAL INSTRUMENT WITH IMAGE BLURRING CORRECTING FUNCTION

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent a user from sensing uncomfortableness by reducing the generation of a driving sound or vibration or the oscillation of a drive control ling loop when sharply driving a correction means without reducing image blurring correcting capacity in a normal application range.

SOLUTION: An optical instrument with an image blurring correcting function having a blurring detecting means for detecting a blurring statea correction means for correcting image blurring due to the blurringa position detecting means for detecting the position of the correction meansand a control means for driving the correction means based on an synthetic signal synthesized from an output of the blurring detecting means and an output of the position detecting means is provided with an amplification gain changing means (#19#20) for reducing the amplification gain of the synthetic signal when the detection result of the position detecting means exceeds a prescribed value.

CLAIMS

[Claim(s)]

[Claim 1] A shake detection means which detects a deflection state.

A compensation means which amends an image shake resulting from said deflection.

A position detecting means which detects a position of this compensation means.

A control means which drives said compensation means based on a composite signal of said shake detection means and said position detecting means.

It had an amplification gain changing means to which it is the optical instrument with an image shake correcting function provided with the above and an amplification gain of said composite signal is reduced when a detection result of said position detecting means becomes larger than a predetermined value.

[Claim 2] The optical instrument with an image shake correcting function according to claim 1 wherein said predetermined value is electrically memorized by nonvolatile memory which can be changed.

[Claim 3] The optical instrument with an image shake correcting function according to claim 1 or 2 wherein a rate of reducing said amplification gain is electrically memorized by nonvolatile memory which can be changed.

[Claim 4] A shake detection means which detects a deflection state.

A compensation means which amends an image shake resulting from said deflection.

A position detecting means which detects a position of this compensation means.

A control means which drives said compensation means based on a composite signal of said shake detection means and said position detecting means.

It had an amplification gain changing means to which it is the optical instrument with an image shake correcting function provided with the above and an amplification gain of said composite signal is reduced when a detection result of said shake detection means becomes larger than a predetermined value.

[Claim 5]The optical instrument with an image shake correcting function according to claim 4wherein said predetermined value is electrically memorized by nonvolatile memory which can be changed.

[Claim 6]The optical instrument with an image shake correcting function according to claim 4 or 5wherein a rate of reducing said amplification gain is electrically memorized by nonvolatile memory which can be changed.

[Claim 7]A shake detection means which detects a deflection state characterized by comprising the followingAn optical instrument with an image shake correcting function which has a compensation means which amends an image shake resulting from said deflectiona position detecting means which detects a position of this compensation meansand said shake detection means and a control means including a drive controlling loop which drives said compensation means based on a composite signal of said position detecting means.

A prediction means which predicts that an oscillation arises to said drive controlling loop.

An amplification gain changing means which makes an amplification gain of said composite signal small according to it being predicted that said oscillation arises by this prediction means.

[Claim 8]The optical instrument with an image shake correcting function according to claim 7wherein said prediction means performs said prediction by comparison with a predetermined value beforehand determined as a detection result of said position detecting means.

[Claim 9]The optical instrument with an image shake correcting function according to claim 8 predicting that said oscillation produces said prediction means when a detection result of said position detecting means is larger than said predetermined value.

[Claim 10]The optical instrument with an image shake correcting function according to claim 7wherein said prediction means performs said prediction by

comparison with a predetermined value beforehand determined as a detection result of said shake detection means.

[Claim 11]The optical instrument with an image shake correcting function according to claim 10 predicting that said oscillation produces said prediction means when a detection result of said shake detection means is larger than said predetermined value.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to improvement of optical instruments with an image shake correcting functionsuch as a camera provided with the function which amends the image shake which originates [shaking hand].

[0002]

[Description of the Prior Art]Since all the work with the present camera important for photography of exposure determinationa focusetc. is automateda possibility that an unripe person will also cause photography failure to camera operation has decreased dramatically.

[0003]Thesedays the system which prevents the shaking hand added to a camera is also studiedand most factors which induce a photography person's photography failure are being lost.

[0004]Herethe system which prevents a shaking hand is explained briefly.

[0005]Although the shaking hand of the camera at the time of photography is usually vibration (1 Hz thru/ or 12 Hz) as frequencyEven if it has started such a shaking hand at the release time of a shutteras a fundamental idea for enabling photography of a photograph without an image shakevibration of the camera by the above-mentioned shaking hand must be detectedand a correcting lens must

be displaced according to the detection value. Therefore even if the deflection of a camera arises in order to attain that the photograph which does not produce an image shake can be taken vibration of a camera is detected [1st] correctly and it is necessary 2nd to amend the optical axis change by a shaking hand.

[0006]The vibration detecting sensor which will detect angular acceleration angular velocity angular displacement etc. if detection of this vibration (camera deflection) is said theoretically It can carry out by carrying in a camera the shake detection means which outputs the signal equivalent to the angular displacement including the integrator etc. which integrate with the output signal of this sensor electrically or mechanically and output angular displacement. And image shake control is attained by making the correcting optical device to which eccentricity of the photographing optical axis is carried out based on this detection information drive.

[0007]Here the outline is explained about the vibration control system using a shake detection means using drawing 5.

[0008]The example of drawing 5 is a figure of the system which controls the image shake originating in the camera length deflection 81p and the lateral deflection 81y of graphic display arrow 81 direction.

[0009]It is a lens barrel and a shake detection means for which 82 detect 83p and 83y detects camera length deflection vibration and camera lateral deflection vibration respectively among the figure and 84p and 84y have shown each deflection detecting direction. 85 -- a correcting optical device (the coil to which 87p and 87y give a thrust to the each correcting optical device 85.) 86p and 86y are position detecting elements which detect the position of the correcting optical device 85 the position control loop mentioned later is provided in this correcting optical device 85 the output of the deflection detector circuits 83p and 83y is driven as a desired value and the stability in the image surface 88 is secured.

[0010]Drawing 6 - drawing 8 are the figures showing the image shake compensator used for the vibration control system explained above. As for the front view (figure seen from the object side of the lens barrel 82 of drawing 5) of a

shake compensating device the side view which as for drawing 6 drawing 7 (a) looked at from the direction of arrow A of drawing 6 and drawing 7 (b) D2-D2 sectional view of drawing 6 and drawing 8 of D1-D1 sectional view of drawing 6 and drawing 7 (c) are the back views of drawing 6 in detail.

[0011] In these figures 71a is the fitting frame provided in division into equal parts at three places at the cope plate 71 fits into the inner circumference of the lens barrel 82 of drawing 5 and is combining both using the hole 71b (refer to drawing 7 (a) and (b)). The stator 74 around which the shift coils 72p and 72y wound around the bobbin were fixed to this cope plate 71 as shown in drawing 8 and the lock coil 73 was wound is being fixed. The rotor 75 is attached to the circumference of the axis pivotable at the cope plate 71 and constitutes the publicly known step motor with this rotor 75 the stator 74 and the lock coil 73.

[0012] At the cope plate 71 the equal long hole 71c (it illustrates to drawing 7 (a) and the arrow shows the position in drawing 6 and drawing 7 (c)) is formed in three places at the peripheral side face. The lock ring 76 (refer to drawing 8) is attached to the rear face of the cope plate 71 pivotable at the circumference of the arrow 76a the pinion 75a and the gear 76a of the rotor 75 mesh and this lock ring 76 is vibrated with a step motor by the circumference of the arrow 76a of drawing 8 (rotation).

[0013] The buck 77 holding a correcting lens (not shown) has the supporting spindle 77a which extends to three division into equal parts in the periphery radial direction as shown in drawing 6 or drawing 7 (a).

The tip part has fitted in with the long hole 71c of the cope plate 71.

[0014] It is fixed in the direction of the optic axis 70 (refer to drawing 7 (a)) and in the optic axis 70 and the right-angled directions sliding of each relation is mutually attained so that clearly [three fitting parts may be the same as that of the relation of the long hole 71c shown in drawing 7 and the supporting spindle 77a respectively and] from a figure (since the hole 71c is a long hole). That is the buck 77 can be freely moved in the vertical flat surface although move regulation

is carried out to the cope plate 71 in an optical axis direction. It will be divided into the pitch direction 78p the direction 78y of a yaw and the roll directions 78r which are shown in drawing 6 if this direction that moves is decomposed.

[0015]As shown in drawing 6 between the pin 77b of the buck 77 and the pin 71d of a cope plate a pair of hauling spring 79 is hung and the buck 77 is pulled from both sides. The shift yoke 711 adsorbed in the shift magnet 710 is attached to the buck 77 and it has countered with the shift coils 72p and 72y on the cope plate 71 (reference such as drawing 7 (b)).

[0016]And by both relation if current is sent through the shift coil 72p the buck 77 will be pulled in the direction of arrow 78p and will be driven against the elastic force of the spring 79 and if current is sent through the shift coil 72y it will pull similarly and will drive to arrow 78 y direction against the elastic force of the spring 79.

[0017]When the buck 77 is driven to the arrow 78p and 78 y directions now based on the deflection information from a vibration detection circuit that the deflection of a camera is detected as mentioned above it is a translation which can attain stabilization of the image surface but while not using the vibration control system the buck 77 needs to make it immobilization to the cope plate 71.

Because it is for avoiding that the buck 77 shakes by the disturbance vibration at the time of carrying etc. and a crashing sound occurs between the cope plates 71 and breakage by it.

[0018]It is a figure showing a state in case drawing 8 does not use a vibration control system and four projections 77e of the buck 77 are in contact with the inner circle wall 76a of the lock ring 76. Therefore as for the buck 77 movement of the arrow 78p and 78 y directions is regulated.

[0019]When using a vibration control system in drawing 10 specified quantity rotation of the lock ring 76 is clockwise carried out with a step motor. Then the projection 77e and the field which counters serve as the cam part 76c and contact leaves it mutually. Therefore the buck 77 becomes free to the lock ring 76 and the drive of it is attained in the arrow 78p and 78 y directions.

[0020]In the image shake compensator of the above composition in order to drive compensation means (the buck 77 an unillustrated correcting lens etc.) with sufficient accuracy and to perform exact shake compensating it is desirable to always supervise the activation point of a compensation means and to feed back the position information to a drive circuit.

[0021]Drawing 9 is the block diagram which materialized an example of the composition.

[0022]Processing of amplification and a highpass filter a low pass filter etc. is made by the digital disposal circuit 3 and the output of the shake detection means 2 is inputted into the microcomputer 1. Within this microcomputer 1 the signal is changed into a digital signal in the A/D conversion part 4 and offset removal highpass filter processing integration etc. are processed by the data processing part 5. Processing of a low pass filter etc. is made by the digital disposal circuit and the output of the position detecting means 6 which detects the position of an unillustrated correcting lens is inputted into the microcomputer 1. Within this microcomputer 1 the signal is changed into a digital signal in the A/D conversion part 8 and amplification etc. are processed by the data processing part 9. And the feedback operation of the output signal of said signal processing parts 5 and 9 is done by the feedback operation part 10 phase lead compensation publicly known in the phase-lead-compensation part 11 of the next step is performed and the driving signal of a correcting lens is outputted to the port of the microcomputer 1. Thereby by the correcting lens driving means 12 an unillustrated compensation means (correcting lens) drives and image shake amendment is performed.

[0023]When not performing image shake amendment and carrying out image shake amendment for a compensation means to a lock (stop) state a locking means is driven in the unlocking (un-stopping) state but the lock unlocking driving means 13 is a thing for performing the drive.

[0024]Since the activation point of a compensation means is not correctly called for when the detecting accuracy of the position detecting means 6 is low it

becomes impossible as mentioned above to drive a compensation means as a desired value although a shaking hand can be amended with sufficient accuracy by using the position control technique.

[0025] The composition in the case of using a photo reflector as an object for detecting positions and carrying out analog detection of the detecting position of a compensation means (correcting lens) for miniaturization of the deflection correcting means 2 is shown in drawing 10 and drawing 11.

[0026] The top view in which drawing 10 shows the important section composition of an image shake compensator and drawing 11 are the figures showing the side view seen from D3-D3 section and the direction of arrow B of drawing 10.

Drawing 6 - the same portion as drawing 8 attach identical codes and the explanation is omitted.

[0027] In drawing 10 the light reflectors 11P and 11y which have wedge-shaped monochrome pattern are formed on the yoke 711. As shown in drawing 11 (a) the photo reflector 12p counters and is formed in the space upper part of this light reflector 11p.

This photo reflector 12p is soldered to the substrate 13 and is being fixed with the cope plate 71.

[0028] Now if the light reflector 11p moves with the drive of the direction of arrow P of the buck 77 the reflectance of an opposed face with the photo reflector 12p will change and thereby the output of the photograph reflector 12p will change. The photograph reflector (un-illustrating) is similarly provided about the light reflector 11y and an output is changed by motion of the light reflector 11y of the direction of arrow Y.

[0029] Since the monochrome rate of the reflection pattern of the light reflector 11p does not change about the direction of arrow Y as shown in drawing 10 the output of the photo reflector 12p does not change in movement of the direction of Y of the light reflector 11p. It is the same the output of the photograph reflector 12y which counters changes only to movement of the direction of Y and the light

reflector 11y does not change in movement of the direction of Peither.

[0030]Thus although a motion of the compensation means of the arrow P and the direction of Y is detected independently the monochrome rate of the reflection pattern of the light reflectors 11p and 11y has the composition that a compensation means counters with a photo reflector in the position (abbreviated drive center) stopped by the locking means.

[0031]When the reflectance of a photo reflector of the light reflector which counters is very low most outputs cannot be found (when there are many black rates) reflectance follows for becoming high (the white rate increases) and an output increases. That is in the position in which the compensation means is stopped both a pair of photo reflectors are carrying out the middle output and these output values change with the sensitivity of a photo reflector. When a middle output is also large when sensitivity is high and sensitivity is low specifically a middle output also becomes small.

[0032]Drawing 13 is an example of the digital disposal circuit of a photo reflector.

[0033]The drive circuit of LED21a which is one of the components of the photo reflector 21 is constituted by the transistor 22 the operational amplifier 23 D/A converter 24 and the resistance R1.

Driving current I_1 of LED21a changes by changing the digital data inputted into D/A converter 24.

It is floodlighted from LED21a and photoelectric conversion of the optical signal reflected with the light reflectors 11p and 11y is received and carried out by the light sensing portion and it is outputted as current I_2 . This current I_2 is changed into voltage from current by the operational amplifier 25 is amplified by the operational amplifier 26 of the next step and is outputted as V_{out} .

[0034]

[Problem(s) to be Solved by the Invention]When a photography person makes intentionally [such as panning] generate large deflections since a deflection detecting signal becomes large the quantity which drives the buck 77 which holds a correcting lens according to it also becomes large. If it does so since the current

amount supplied to the shift coils 72p and 72y for driving the buck 77 also increases a driving sound increases vibration arises the vibration gets across also to a lens barrel and displeasure may be given to a photography person.

[0035] In the time of the buck 77 being near a center and the time of drive quantity becoming large and being in an end the frequency characteristic of an amendment system may change it may become unstable and vibration may become large. But when the flattery nature of an amendment system is reduced the fall of amendment capability will be caused.

[0036] (The purpose of an invention) The purpose of this invention without reducing image shake amendment capability in the anticipated-use range The driving sound at the time of making a compensation means drive greatly and vibration and the oscillation of a drive controlling loop tend to be decreased and it is going to provide the optical instrument with an image shake correcting function which can be prevented from giving a user displeasure.

[0037]

[Means for Solving the Problem] In order to attain the 1st purpose of the above this invention according to claim 1 to 3 What is used as an optical instrument with an image shake correcting function with an amplification gain changing means to which an amplification gain of said composite signal is reduced in an optical instrument with an image shake correcting function characterized by comprising the following when a detection result of said position detecting means becomes larger than a predetermined value.

A shake detection means which detects a deflection state.

A compensation means which amends an image shake resulting from said deflection.

A position detecting means which detects a position of this compensation means.

A control means which drives said compensation means based on a composite signal of said shake detection means and said position detecting means.

[0038] In order to attain the 1st purpose of the above similarly this invention

according to claim 4 to 6 What is used as an optical instrument with an image shake correcting function with an amplification gain changing means to which an amplification gain of said composite signal is reduced in an optical instrument with an image shake correcting function characterized by comprising the following when a detection result of said shake detection means becomes larger than a predetermined value.

A shake detection means which detects a deflection state.

A compensation means which amends an image shake resulting from said deflection.

A position detecting means which detects a position of this compensation means.

A control means which drives said compensation means based on a composite signal of said shake detection means and said position detecting means.

[0039] In order to attain the 1st purpose of the above similarly this invention according to claim 7 to 11 A shake detection means which detects a deflection state which is characterized by that what is used as an optical instrument with an image shake correcting function comprises the following An optical instrument with an image shake correcting function which has a compensation means which amends an image shake resulting from said deflection a position detecting means which detects a position of this compensation means and said shake detection means and a control means including a drive controlling loop which drives said compensation means based on a composite signal of said position detecting means.

A prediction means which predicts that an oscillation arises to said drive controlling loop.

An amplification gain changing means which makes an amplification gain of said composite signal small according to it being predicted that said oscillation arises by this prediction means.

[0040]

[Embodiment of the Invention] Hereafter this invention is explained in detail based on the embodiment of a graphic display.

[0041] Drawing 1 is a block diagram showing the composition of the image shake compensator concerning the 1st gestalt of operation of this invention and the case where it applies to the interchangeable lens of a single-lens reflex camera is assumed in this embodiment.

[0042] In drawing 1 31 is a lens microcomputer and is performing control by the side of a lens by communication with a camera. 32 is a shake sensor which is a shake detection means which detects deflection. 33 is HPF the amplification and an LPF circuit which cuts a DC component with a highpass filter carries out noise rejection of the signal from said shake sensor 32 by amplification and also a low pass filter and outputs it to the A/D conversion terminal of MPU31 as a shake signal.

[0043] The position detecting means which performs the detecting position of a correcting lens can change the sensitivity of a detecting position by changing the data which shall be the same composition (refer to drawing 12) as what was shown by the conventional example and is outputted to D/A converter 24 from MPU31. And the detecting position output Vout is inputted into the A/D conversion input terminal of MPU31.

[0044] The feedback operation of said two shake signals and position detection signals is done within MPU31 a correcting lens is driven via the coil driver 35 and an image shake is amended. Lock a correcting lens when not performing image shake amendment when performing image shake amendment unlock (lock release) but. The composition presupposes that it is the same as that of the composition shown by the conventional example drives a stepping motor via Motor Driver 34 and performs lock unlocking by rotating the lock ring 76 (refer to drawing 8) in the direction of arrow 76r.

[0045] MPU31 is performing zone detection of the drive of a focus lens a diaphragm drive and the output of the zoom focus position detecting circuit 36 to the zoom focus other than the above image shake correction control via Motor

Driver 37 and 38.

[0046]EEPROM 39 has remembered locked position data the sensitivity of the shake sensor 32 etc. to be The selecting switch (ISSW) of whether 40 performs image shake amendment (Image Stabilizer) of operation and 41 are switches (A/municipal solid waste) which choose auto-focusing or manual focus.

[0047]Next concrete operation of MPU31 is explained using the flow chart of drawing 2. If a camera is equipped with a lens serial communication will be made from a camera to a lens and MPU31 will start operation from step #1.

[0048]First in step #1 initial setting for lens control and image shake correction control is performed. The contents of EEPROM39 are copied to RAM of MPU31. Here EEPROM39 is copied for the predetermined value of the shake sensor 32 and the rate of a fall of a loop gain which are the position detecting means for performing a loop gain and making a loop-gain change to RAM.

[0049]In the following step #2 the state detection of the switches 40 and 41 and the detecting position of a zoom focus are performed. And in the following step #3 it is judged whether there was any focal drive request communication from a camera. Since it will progress to step #4 and will be ordered in the drive quantity of a focus lens from a camera here if a focal drive request occurs focal drive controlling is performed according to it and it returns to step #2.

[0050]When there is no focal drive request the above-mentioned step #3 it progresses to step #5 and according to the state of the communication from a camera and the switch 40 control of lock unlocking and setting out of image shake amendment beginning flag IS_START are performed here. Although explained in detail later a sensitivity calibration etc. are performed here. In the following step #6 it is judged whether all the driving stoppage (all the drives of actuator in lens are suspended) commands were received from the camera. If no operations are made by the camera side these the driving stoppage commands of all the will be transmitted from a camera after a while. If these the driving stoppage commands of all the have not been transmitted it returns to step #2 but when transmitted it progresses to step #7 and all the drive stop control is performed. That is all the

actuator drives are suspended and a microcomputer is changed into a sleep (stop) state. The electric supply to an image shake compensator is also stopped. Then if some operations are performed by the camera side a camera will send communication to a lens and will cancel sleeping.

[0051] If the demand of serial communication interruption by the communication from a camera and image shake correction control interruption is among these operations those interrupt processing will be performed.

[0052] Said serial communication interrupt processing performs lens processing of decoding of communication data a diaphragm drive etc. And the model of camera etc. can be distinguished by decoding of communication data at the time of ON of switch SW1 (switch for a photographing-preparation-operation start) ON of switch SW2 (switch for a release operation start) and a shutter second.

[0053] Image shake amendment interruption is a timer interrupt generated for every (every [for example] 500 microsec) constant period. And since pitch direction (lengthwise direction) control and the direction (transverse direction) control of a yaw are performed by turn the sampling period of the uni directional in this case serves as 1 msec. Since there are many portions with same both directions a program is accepted one line and the control method creates it. the control methods (operation coefficient etc.) since results such as an operation naturally serve as separate data in a pitch direction and the direction of a yaw even when it is the same a base address is set to a pitch by a yaw respectively the data of the result of an operation etc. is specified with the indirect address of RAM and it is calculating by being at the pitch control and yaw control time and switching a base address.

[0054] If an image shake amendment interrupt occurs working mainly [a camera] MPU31 will start control of image shake amendment from step #11 of drawing 3.

[0055] In step #11 the A/D conversion of the output of the angular velocity sensor which is the shake sensor 32 is carried out and the state of image shake amendment beginning flag IS_START is judged in the following step #12. As a

results since it will progress to step #13 and image shake amendment will not be performed if the image shake amendment beginning flag is cleared. Initialization of highpass and an integration operator is performed. And it progresses to step #16.

[0056] When the image shake amendment beginning flag is set in the above-mentioned step #12 in order to progress to step #14 and to operate image shake amendment, a highpass filter operation is performed. A damping time constant is switched for 2 to 3 seconds from the start of image shake amendment and it also performs easing the image shake of a standup. And it progresses to the following step #15 and the integration operator of the characteristic set up here is performed. This result becomes the angular displacement data θ . When panning is carried out it is also performing switching the cut off frequency of integration according to deflection angle displacement.

[0057] In the following step #16 since the eccentricity (sensitivity) of the correcting lens to deflection angle displacement changes with the positions of a zoom focus the adjustment is performed. Specifically zoom and a focal position are divided into some zones respectively. The average vibration-proof sensitivity (deg/mm) in each zone is read from table data and it changes into correcting lens drive data. The result of an operation is stored in the RAM area set up by SFTDRV in the microcomputer 31. And in the following step #17 the A/D conversion of the position sensing device output of a correcting lens is carried out and an A/D result is stored in the RAM area set up by SFTPST in the microcomputer 31. In step #18 continuing a feedback operation (SFTDRV-SFTPST) is performed and the result is stored in RAM set up by SFT_DT.

[0058] The reference value SFTLPGCH which performs the detecting position output SFTPST and loop-gain change of the correcting lens stored in RAM in step #19 is compared. If the detecting position output SFTPST is beyond the reference value SFTLPGCH it will progress to step #20 and if small it will progress to step #21. In step #20 the multiplication of loop-gain data LPG_DT and feedback result-of-an-operation SFT_DT is carried out and it stores in RAM set up by SFT_PWM. In the following step #22 in order to use a stable control system a

phase compensation operation is performed in step #23 continuing it outputs to the port of the microcomputer 31 by setting the result of said step #22 to PWM and interruption is completed.

[0059] In step #19 as mentioned above when the detecting position output of a correcting lens is larger than the reference value of loop-gain change that is in step #20 when it judges with beyond the predetermined value with a correcting lens driving since he is trying to reduce a loop gain in an image shake amendment system is stabilized and it is lost that a driving sound and vibration increase.

[0060] Since the reference value of loop-gain change is set as the value which does not reach in the time of the usual stock the image shake amendment capability at the time of the usual stock without deflection on purpose does not decline.

[0061] In step #19 when the detecting position output of a correcting lens is larger than the reference value of loop-gain change (i.e. when it judges with beyond the predetermined value with a correcting lens driving) Since he is trying to reduce a loop gain it can prevent an oscillation arising to a drive controlling loop and it can be made to stabilize an image shake amendment system in step #20 since a drive controlling loop has a possibility that an oscillation may arise (it can predict).

[0062] (The 2nd gestalt of operation) Drawing 4 is a flow chart which shows operation (operation of the portion corresponding to above-mentioned drawing 3) of the main part of the image shake compensator concerning the 2nd gestalt of operation of this invention and is explained according to this below. Since it is the same as that of the 1st gestalt of the above-mentioned implementation about other composition and operation the explanation is omitted.

[0063] It is made to judge whether the 2nd gestalt of this operation makes a loop-gain change based on the output of a shake detection means the portion which performs the same operation as each step of drawing 3 attaches the same step number and that explanation is omitted.

[0064] In step #24 SFTDRV stored in RAM based on the signal of an angular velocity sensor is compared with the reference value SFLPGCH which performs

loop-gain change if SFTDRV is beyond the reference value SFLPGCHit will progress to step #20 and if small it will progress to step #21.

[0065] As mentioned above in step #24 when a deflection detected amount is larger than the reference value of loop-gain change (i.e. when it judges with the photography person's deflection on purpose having occurred). In step #20 since he is trying to reduce a loop gain an image shake amendment system is stabilized and it is lost that a driving sound and vibration increase.

[0066] Since the reference value of loop-gain change is set as the value which does not reach in the time of the usual stock the image shake amendment capability at the time of the usual stock without deflection on purpose does not decline.

[0067] In step #24 when a deflection detected amount is larger than the reference value of loop-gain change (i.e. when it judges with the photography person's deflection on purpose having occurred) Since he is trying to reduce a loop gain it can prevent an oscillation arising to a drive controlling loop and it can be made to stabilize an image shake amendment system in step #20 since a drive controlling loop has a possibility that an oscillation may arise.

[0068] (Modification) Although the 1st and 2nd gestalten of the above-mentioned operation showed the example which is sharing the program of a pitch and a yaw you may provide independently. Although the example for performing by digital control was shown it may carry out by analog control.

[0069] Although the image shake compensator showed the example included in the interchangeable lens it is very good in the gestalt as accessories which enter into [which] the conversion lens which there is no image shake compensator into an interchangeable lens and is attached ahead of an interchangeable lens.

[0070] It may apply to camera such as a lens shutter camera and a video camera and can apply also as other optical instruments other devices and a component unit further.

[0071] In the above-mentioned embodiment although the angular velocity sensor is made into the example as a shake sensor as long as an angular acceleration

sensoran acceleration sensora velocity sensoran angular displacement sensora displacement sensorthe method of detecting the picture deflection itselfetc. can detect deflectionthey may be what kind of things.

[0072]Although the photo reflector was used as a position detecting meansif positionssuch as PSDare detectableit may be what kind of thing.

[0073]

[Effect of the Invention]Without reducing image shake amendment capability in the anticipated-use range according to this inventionas explained aboveThe driving sound at the time of making a compensation means drive greatlyand vibration and the oscillation of a drive controlling loop are decreasedand the optical instrument with an image shake correcting function which can be prevented from giving a user displeasure can be provided.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the composition of the interchangeable lens carrying the image shake compensator of the 1st gestalt of operation of this invention for single-lens reflex cameras.

[Drawing 2]It is a flow chart which shows main operation with the microcomputer of drawing 1.

[Drawing 3]It is a flow chart which shows the image shake correction control operation concerning the gestalt of ** of operation of this invention.

[Drawing 4]It is a flow chart which shows the image shake correction control operation in the 2nd gestalt of operation of this invention.

[Drawing 5]It is a perspective view for explaining the conventional vibration control system.

[Drawing 6]It is a front view showing an example of the composition of the conventional image shake compensator.

[Drawing 7] It is a figure showing the side and the section of an image shake compensator of drawing 6.

[Drawing 8] It is a back view of drawing 6.

[Drawing 9] It is a block diagram showing a control flow of the conventional image shake compensator.

[Drawing 10] It is a front view showing other examples of composition of the conventional image shake compensator.

[Drawing 11] It is a sectional view of the main part of the image shake compensator of drawing 10.

[Drawing 12] It is a circuit diagram showing the composition of the position detecting means of the image shake compensator of drawing 10.

[Brief Description of Notations]

21 Photo reflector

24 D/A converter

31 MPU

32 Shake sensor

33 The coil driver for a correcting lens drive

34 Motor Driver for a lock unlocking drive

39 EEPROM
